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ABSTRACT

Computers have the potential of creating new barriers and widening the gap between disabled and able-bodied people, because computers are extending the capabilities of non-handicapped individuals at a greater rate than for the handicapped. Access to standard computers and standard software must be provided to handicapped individuals by either modifying the software, which is prohibitively expensive, or by providing transparent access via a keyboard emulator or tactile and voice devices. The analogy of building sidewalks and not including curbcuts is used to describe the situation of advancing technology failing to include access points for the handicapped. (JDD)

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# CURBCUTS AND COMPUTERS:

## PROVIDING ACCESS TO COMPUTERS AND INFORMATION SYSTEMS FOR DISABLED INDIVIDUALS

September 1983

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Keynote Speech Presented At:
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Office of Continuing Education
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Closing the Gap

September 12, 1983

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# CURBCUTS AND COMPUTERS:

# PROVIDING ACCESS TO COMPUTERS AND INFORMATION SYSTEMS

# FOR DISABLED INDIVIDUALS

Excerpted from a Keynote Speech at the
Indiana Governor's Conference on the Handicapped
October 13, 1983

Gregg C. Vanderheiden
Trace R&D Center
on Communication, Control, and Computer Access
for Handicapped Individuals
University of Wisconsin-Madison

This morning I'd like to talk to you about some of the potential for microcomputers, but, more importantly, I'd like to talk to you about how computers can become the greatest new handicap that disabled people will ever face. I'd also like to talk about a few approaches we can take to see to it that it doesn't happen, or to turn this trend around early.

Many special programs have been written for individuals experiencing handicaps. These include programs to allow blind individuals to auditorily process text, translate text into Braille, and translate Braille back into text; programs to help deaf individuals learn sign language or better understand how to move their vocal mechanisms in speech (by displaying cut-away views of the mouth during speech); and programs to allow physically handicapped individuals to write, speak, and control items in their environment. It is clear that with these programs we can use the computer to do all sorts of wonderful things which can assist individuals who have various disabilities. At this point, the computer still looks like a "good guy".

But that's only half of the story. Let's look at the other half -- where computers have the very great potential of creating new barriers and widening the gap between disabled and able-bodied people, rather than helping the disabled individual overcome these gaps.

How does a computer become a barrier? First, we have to realize that the computer was not invented for the individual with a disability. We get so excited about all of the potentials and potential uses of the computer to carry out special activities for individuals who have disabilities that we forget that the reason computers were developed, and the reason the technology is racing ahead and the prices are dropping, is that they are very rapidly being applied and incorporated into the lives of non-handicapped individuals. They are extending the capabilities of able-bodied individuals, increasing their efficiency and effectiveness, and providing them with new capabilities. Computers are now beginning to show up and will show up at an ever-increasing rate in our educational system. Soon there will be computers in all classrooms, and they will be used as

routinely as blackboards and pencils and paper are today. Similarly, employers are making more and more extensive use of computers in all aspects of employment. Even in daily life, we may soon be doing most of our ordering and bill-paying using computer terminals and the like from our homes. In all of these cases, however, the software is being written to be operated by individuals who have use of all senses and fingers. As such, they are for the most part unusable by individuals who have various types of physical disabilities. Thus while we are busy providing handicapped individuals with ways of using a computer to act like a typewriter, pencil and paper, or environment control system, to parallel the manual activities of non-handicapped individuals, the rest of society is busy moving on to the next generation, where many of these activities will be carried out much more efficiently and effectively in totally different ways using computer technology. Moreover, these new ways are designed to make maximum use of all of the senses and movement patterns of able-bodied individuals, and will thus exclude the handicapped individuals.

So, while the computer is advancing handicapped individuals two steps through the use of special programs designed for handicapped individuals, the computer is advancing everyone else in society five steps. Moreover, the five steps are being designed in such a way that the handicapped individual can not take advantage of them, thereby leaving them actually three steps behind.

For example, we now find bright physically handicapped individuals being placed in the classroom, where half of the classwork is being done on computers. Although these handicapped individuals have the few special programs which have been written for them, and which they can operate with their limited physical abilities, they are unable to use the much larger (on the order of a hundred to a thousand times larger) body of standard software which is being used by the rest of their class, since they are physically unable to operate it. As a result, half of the classwork (and the educational system) is inaccessible to them.

Other individuals, moving into the job market, find that companies are not interested in the fact that these handicapped individuals can use their own computer and their specially adapted programs. The employer is only interested in whether the disabled individual is able to operate the accounting program running on the company's computer. If not, then he can't carry out the job, and is unemployable, despite the fact that he "has a computer and a program he can operate." Care must be to taken to distinguish between having the ability to do something or operate a computer and the ability to operate the programs and computers that are required. This is roughly akin to being able to easily access your bathroom at home, which does you little or no good if you have to go to the bathroom on the job. It's not enough that you can access a bathroom -- you have to be able to access the bathrooms that are in the environments where you need to operate.

Even in the home, however, this problem can arise. As we move toward telecommunication systems where ordering and bill-paying is carried out through specialized communication links, it will become necessary for the handicapped individuals to operate the specific keypads or control panels on these auto-home communication systems. If standard computer terminals were used, then a specially adapted "terminal for the handicapped" might be

usable. More likely, however, due to security and other considerations, very specialized systems will be used, and what could be a very powerful capability for handicapped individuals (remote ordering and billpaying) will instead be available only to non-disabled individuals.

Thus, although custom software programs can provide a great number of very useful capabilities to handicapped individuals, custom software is not enough. Access must be provided to the world of standard computers and, most importantly, the world of standard software, if computers are in fact to result in a net gain for handicapped individuals.

The first method that comes to mind for providing access to standard software is to simply modify the software so that it can also be used by handicapped individuals. However, this is an extremely and difficult proposition, even when support from the original software developers is available. Again, because of security and commercial reasons, most standard software is a carefully guarded and protected commodity, making modification almost impossible. Moreover, the software programs are continuously updated and revised, making it impossible to keep handicapped users supplied with a modified version. It should be remembered that modifying a single program can cost between $8,000 and $20,000; writing a program from scratch can cost anywhere from $5,000 to $2,000,000 and up.

The only real solution to the problem is therefore the ability to provide transparent access to computers. Transparent access refers to the ability of the handicapped individual to access the computer in such a way that the computer program cannot tell in any way that the input is not coming to it in the standard fashion. For example, if a program is written to accept input from the keyboard, the modification must be made in such a way that it is impossible for the program to tell that the input is not coming from the keyboard.

One technique that can be used is a keyboard emulator. The keyboard emulator is a small module which is installed inside a computer between its normal keyboard and the rest of the computer. Once installed, it does not affect the operation of the computer in any way. The keyboard operates in exactly the same fashion as it did before. The emulator, however, provides a small port or plug point where individuals using specialized communication aids can connect. They can then use their specialized communication systems (which they may operate using eye movements, head movements, or sip-and-puff, etc.) to generate their "keystrokes" which are then fed to the keyboard emulator. The keyboard emulator in turn feeds them into the computer in such a way that it looks as if they were actually typed on the computer's keyboard. With a keyboard emulator installed in a computer, a wide range of individuals having very different communication aids and input techniques would be able to use the computer and all of its software without requiring any modifications of any kind to any software.

In a classroom, for example, there might be fifteen computers lined up along one wall on which the students carry out their written assignments, etc. Two of the computers might have keyboard emulators installed in them, and a small "access" sticker similar to that found on restrooms placed on the computers' cases. Any individuals who are unable to use the standard input keyboard could then use these two computers and control them using their specialized communication or writing systems. When not being used by

handicapped individuals, these two computers could be used by anyone else. The situation would in fact look very much like a bathroom, where one or two stalls have been modified for use by handicapped individuals. The difference here would be that the non-handicapped individual would not be to distinguish in any way (except, perhaps, by seeing the access sticker) that any type of modifications had been made to the system.

Keyboard emulators are currently available for the Apple II and Apple IIe computers, with emulators for the IBM, Atari, and many other computers following quickly. More information about these and other transparent and non-transparent modifications to computers is available in the Software/Hardware Registry distributed by the Trace R&D Center.

For visually impaired individuals who cannot use the CRT display, substitute displays using tactile and voice output are under discussion and development. One system uses a pad about the size of a pad of paper, which the blind individual touches. Wherever he touches the pad, the contents of the CRT screen corresponding to that portion of the pad are read vocally to him. This system can therefore be used by individuals who are blinded later in life as well as those who are congenitally blind, since it does not require any learning of special skills, such as Braille, etc.

The problem, however, is not solved yet. While we are now coming up with solid solution strategies to deal with transparent access to keyboards, the computer designers are busy inventing non-keyboard methods for input to computers. Most of these input methods take increased advantage of the many physical abilities of the non-handicapped individual; as a result, they are even more difficult for handicapped individuals to operate than the keyboard. These input techniques include "mice", voice inputs, and body tracking techniques. In addition, more complex video displays are being used, with heavy use of graphics and visual-spatial representation, which will make the task of providing alternate displays for visually impaired individuals even more difficult. The development of new strategies to deal with these problems, as well as the raising of the awareness level of computer designers to these problems, is therefore very important, and needs to be one of our highest priorities.

So, where do the curb cuts come in? Let's imagine for a moment a town where there are only roads, and no sidewalks of any kind. Individuals in wheelchairs are not allowed on the road, and are therefore trundling their chairs across the grass. This of course is a very difficult activity, so they greet with great anticipation and joy discussions about putting little concrete runways along the side of all the roads, on which people can walk. Although it's clear that these walkways aren't being put in for the specific benefit of handicapped individuals, it also appears that it will be a tremendous boon to them. In all the celebration, though, people don't notice that along with the sidewalks come curbs. Thus, when the whole system is installed, the handicapped individuals find that they are now able to move very swiftly around on their own block, but for the most part are unable to access these nice pathways that have been laid throughout the society. Moreover, putting in the paths increased everybody else's ability to get around, thus making the difference between their mobility that much greater. They could put ramps on the sidewalks near their homes, or in the places that they go to a lot, but they really need to be able to access all of the little pathways if they are to be able to get around and about.

Today, we find ourselves in exactly the same situation with regard to the area of computers and information systems. Very rapidly, our society is moving toward electronic assisted everything. In the process, electronic pathways are being laid throughout our society -- pathways which could tremendously increase the functional mobility and capabilities of individuals with physical and sensory disabilities. All of these electronic information pathways will be of little use, however, if unrestricted access is not available. Patching one or two access points is not sufficient, in the same manner that providing curb ramps or curb cuts for some of the sidewalks is not sufficient.

My message to you today is, let's not wait until all of the sidewalks have been laid and the curbs poured before we begin talking about curb cuts. It's incredibly expensive to go back and tear everything up to install the curb cuts later. Let's identify the problem and move now so that we can pour the curb cuts and provide unrestricted transparent access while we are laying these electronic pathways.

It is certainly a bright, shiny and dynamic field. The potentials are enormous. But as it races ahead -- and continues to evolve -- it will be a continuing challenge to make sure that we maintain open channels of access -- unlimited unhandicapped access -- to these systems and all of their software. This applies not just to computers, but to the information systems they are going to generate. As we go through our society developing and creating these wonderful computer systems and information highways, let's make sure we don't forget to build the means to access them at the same time.

## For More Information

The Bulletin of Science and Technology for the Handicapped
American Association for the Advancement of Science
1515 Massachusetts Avenue
Washington, DC 20005

Closing the Gap Newsletter on computers and handicapped individuals
Budd Hagen, Editor
Route 2, Box 39
Henderson, Minnesota 56004

Communication Outlook
Artificial Language Laboratory
Michigan State University
East Lansing, Michigan 48824

COPH Bulletin
Congress on the Physically Handicapped
101 Lincoln Park Blvd.
Rockford, Illinois 61102

International Software/Hardware Registry
Trace Research and Development Center
314 Waisman Center
1500 Highland Avenue
Madison, Wisconsin 53706

Link and Go
(includes COPH Bulletin, above)
2030 Irving Park Road
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